Engineering Educators Bringing the World Together
2025 ASEE Annual Conference & Exposition
Palais des congrès de Montréal, Montréal, QC • June 22–25, 2025
Paper ID #47600

BOARD #126: The Accidental Design Teacher: Educating Without a Formal Design Education

Ms. Yuwei Deng, King's College London

Yuwei Deng is a PhD student at King's College London. Her work examines how design thinking methodologies can be effectively integrated into engineering curricula to enhance both staff teaching approaches and student learning outcomes, with the aim of equipping future engineers with creative problem-solving skills for complex challenges.

Dr. Wei Liu, King's College London

Dr Wei Liu is Senior Lecturer (Associate Professor) at King's College London with extensive teaching and research experience across design, engineering and management.

Wei accomplished her PhD at the University of Cambridge and was Visiting Fellow at H

Prof. Claire Lucas, King's College London

I specialise in designing transformative engineering programs aligned with global challenges. As Deputy Head (Education) at King's College London, I have led innovative curriculum reforms, established a create-first pedagogy for project-based and experiential learning, and shaped national standards.

The Accidental Design Teacher: Educating Without a Formal Design Education

Abstract:

This research examines the implementation of design thinking within UK undergraduate engineering programs, analysing integration patterns and key challenges. A systematic review of 61 engineering institutions reveals significant disparities in design education implementation across engineering curricula. Only 8 institutions were found to directly introduce design-related courses within their engineering curricula, and a wide disparity exists in how design is embedded across different fields.

Upon further examination, the study identified significant variations in the educational backgrounds of the educators responsible for teaching design. Semi-structured interviews with seven engineering educators identify six primary challenges: educator identity reconstruction, inadequate training opportunities, student resistance to design thinking principles, resource constraints, industry collaboration barriers, and assessment complexities. The findings highlight how these challenges interact and compound each other, particularly in how resource limitations affect both teaching quality and industry engagement.

The findings suggest that the inconsistent integration of design into engineering programs poses significant challenges for developing well-rounded engineers. This study contributes to understanding design thinking implementation in engineering education and suggests the need for systematic changes in curriculum development, educator support, and resource allocation to better prepare engineers for complex, interdisciplinary problems.

1. INTRODUCTION

The integration of design thinking into engineering education has gained increasing attention as industries demand graduates equipped with creative problem-solving skills, interdisciplinary collaboration capabilities, and adaptability in the face of complex challenges[1, 2]. Design Thinking (DT) has emerged as a valuable skillset that fosters creativity, collaboration, and problem-solving abilities among engineering students [3, 4]. This approach enables future engineers to develop both technical expertise, and the innovative mindset required to address complex industrial challenges [1]. While engineering education institutions increasingly recognize the importance of design thinking, its integration into curricula remains inconsistent due to the absence of standardized implementation frameworks [5, 6].

The challenge of integrating design thinking is evident in the emergence of what might be termed "accidental design teachers" - engineering educators who find themselves teaching design principles without formal design training [7]. Current research indicates diverse approaches to incorporating design thinking in higher engineering education (HEE) [3, 8] from dedicated design thinking courses to integrated principles throughout engineering programs [7]. However, comprehensive research on effective implementation strategies remains limited, particularly regarding the practical challenges these educators face in delivering design education while navigating their own limited experience with design principles.

This study explores the integration of design thinking into UK engineering education, focusing on the research questions:

1. What are university engineering educators' theoretical understandings of design thinking?
2. What challenges do educators face in teaching design thinking?

This study is structured as follows: Section 2 provides background on the current state of design integration in engineering education. Section 3 details the research methodology, including course review and interview approaches. Section 4 presents the findings across six key themes, and Section 5 discusses implications for engineering education practice. The paper concludes with recommendations for enhancing design thinking integration in engineering curricula.

2. BACKGROUND

2.1 Current State of Design Integration in engineering education

An analysis of general engineering education across 61 UK institutions shows limited integration of design-focused courses, with only 8 institutions explicitly incorporating such courses into their curricula. Further investigation through UCAS[9] (https://www.ucas.com/) identified 77 general engineering courses offered by 42 providers, representing approximately 10% of surveyed programs, as shown in Figure 1. This low proportion indicates a gap between current curriculum structures and the growing need for design-oriented engineering education.

As shown in the word cloud in Figure 1, the terms such as "Sustainable," "Interdisciplinary," and "Integrated" appear frequently, suggesting increasing recognition of cross-disciplinary perspectives and sustainability principles. The presence of keywords like "Challenge," "Practice," and "Analysis" indicates growing emphasis on experiential learning methods. However, the implementation of these approaches varies significantly across institutions.

While design elements may be integrated within other course components rather than as standalone modules, this implicit integration creates potential challenges. Prospective students reviewing course descriptions may not recognize the design content available within programs,

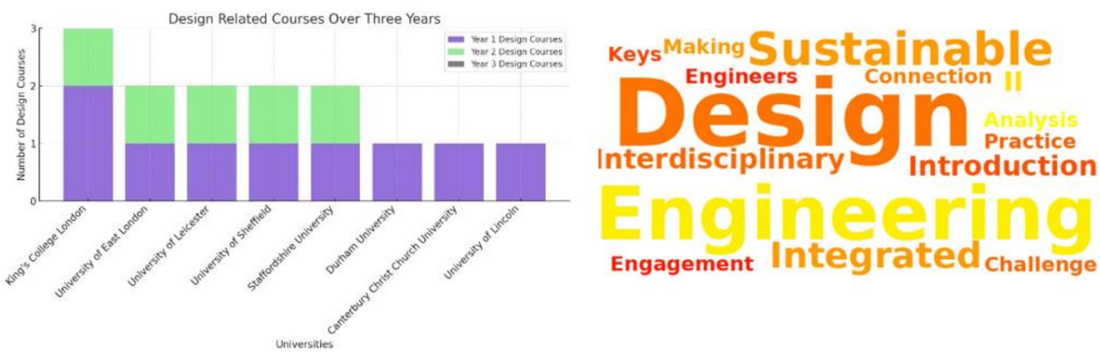

Figure 1. Design related courses distribution of years and themes.

potentially affecting their program selection decisions. This lack of visibility in course descriptions could lead to misaligned expectations between student interests and program content, particularly for those seeking strong design-oriented engineering education.

Engineering Design Coverage Across Disciplines

The Figure 2 shows four different quadrants representing different approaches to the integration of design courses in the engineering profession. This framework maps the relationship between course specificity (specific vs. generic design) [10] and disciplinary coverage (high vs. low).

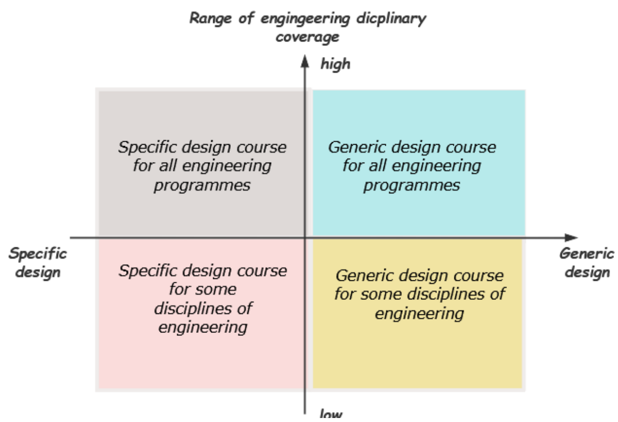

Figure 2 Distribution of Design Course Types in Engineering Education

In the upper left quadrant, programs offer specific design courses that serve all engineering disciplines, representing a comprehensive yet specialized approach. This strategy ensures consistent design education while maintaining discipline-specific relevance.
The upper right quadrant shows programs implementing generic design courses across all engineering disciplines. This approach prioritizes broad design principles applicable to multiple engineering contexts, fostering interdisciplinary understanding. The lower left quadrant indicates programs providing specific design courses for selected engineering disciplines. This targeted approach allows for specialized design education but reaches a limited number of students. The lower right quadrant represents programs offering generic design courses to certain engineering disciplines. While these courses provide general design principles, their limited availability may create gaps in design thinking preparation across the engineering student population.

In the context of inconsistent curricular structures, educators play a critical role in bridging the gap between course frameworks and practical implementation. Many educators express concerns about their ability to effectively integrate design thinking into teaching practices, particularly in the absence of formal training or adequate resources. The diversity of educators' backgrounds and the variability of course design components have led to significant differences in teaching approaches and outcomes.

To better understand these implementation challenges, semi-structured interviews were conducted with seven engineering educators from diverse academic and professional backgrounds. These educators, representing both engineering and design disciplines, provided insights into the practical barriers, resource constraints, and pedagogical difficulties involved in fostering design thinking within engineering curricula. Through examination of educator experiences, this research aims to illuminate pathways for addressing these challenges and strengthening the integration of design within engineering education.

3 METHODOLOGY

3.1 Course Review

The initial phase of this study focused on evaluating undergraduate engineering programmes in the UK to understand the integration of design principles within their curricula. Institutions were required to offer at least two distinct engineering disciplines within their three-year, full-time undergraduate programs to ensure sufficient diversity and interdisciplinarity. Institutions without a dedicated focus on engineering, such as those lacking specialized organisational structures, were excluded.

This review began with 85 institutions, narrowed to 63 based on scale and structure, and ultimately to 61 after accounting for accessibility issues. Using the University and College Admissions Service (UCAS) as the primary research tool, a search was conducted for the academic year 2024–2025 to identify programs accredited by the Institution of Engineering Designers (IED) or the Institution of Engineering and Technology (IET). The UCAS search was complemented by direct reviews of university websites, course catalogues, and program specifications, providing a comprehensive analysis of how curricula incorporate Engineering and Design principles.

3.2 Qualitative Research Design

To deepen the insights gained from the course review, this study employed a qualitative research design, focusing on the experiences and perspectives of educators [11]. The semi-structured interview [12] format provided a systematic yet flexible approach to data collection[12]. Key themes were identified by open-ended questions, and responses were analysed to uncover patterns and variations in the implementation of design thinking[13].

Data Collection

To address the research question, semi-structured interviews were conducted between March 2024 and November 2024 with seven educator participants from six higher education institutions in the UK. These educators were selected to represent diverse academic disciplines and levels of experience within engineering departments, offering varied insights into the integration of design thinking in engineering education. The participants were initially contacted through email invitations and invited to contribute to the study.

The sampling process began with two educators whose courses were already recognized for integrating design thinking principles. Using snowball sampling methods[14], the participant pool expanded to seven educators across six institutions. This approach allowed the study to target individuals with direct experience in applying design thinking while leveraging participants' professional networks to identify additional contributors. These participants came from a variety of subject areas and had varying levels of experience and years of experience in the engineering department, as detailed in Table 1.

Table 1 Demographic Information of Engineering Educators Interviewed

Participant ID (Pseudonym)	Main Academic Discipline	Academic Title	Years of Experience in Engineering Education
ID-1	Design and Mechatronics	Senior Lecturer	3 years
ID-2	Mechanical Engineering	Lecturer	7 years
ID-3	Design and Innovation	Senior Lecturer	8 years
ID-4	Industrial Design	Assistant Lecturer	1 year
ID-5	Engineering Design and Manufacture	Senior Lecturer	6 years
ID-6	Design Engineering	Senior Lecturer	13 years
ID-7	Engineering Mechanics	Professor	24 years

The selected participants represent institutions across the four identified integration models, offering perspectives on how different approaches to design education manifest in practice, as detailed in Figure 3. While some participants teach multiple course types, the study focused on one specific course per educator to enable detailed examination of design thinking implementation. This focused approach allowed for in-depth exploration of practical challenges and experiences within each course context.

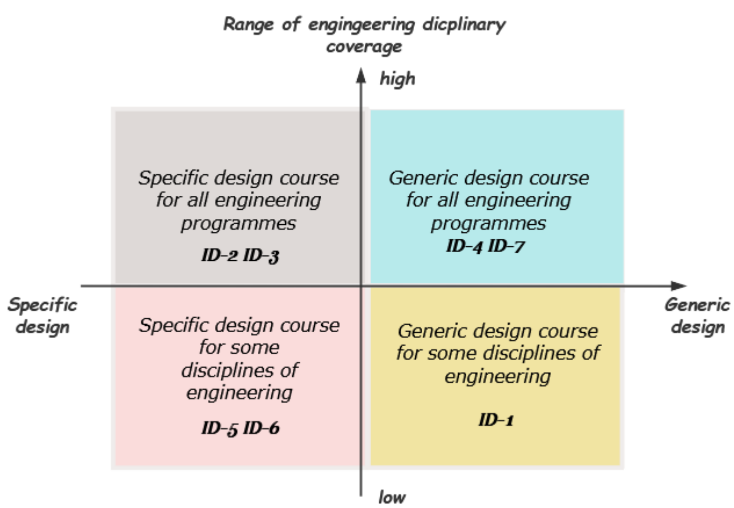

Figure 3 Classification of Design Course Coverage and Participant Teaching Contexts

The research team conducted preliminary background research on each participant's teaching context to inform the interview guide development[12]. Three authors collaborated to create and refine this guide, ensuring methodological consistency and alignment with the study's research objectives. The guide structured discussions around three areas: theoretical understanding of design thinking, practical teaching implementation, and encountered challenges in the educational context. The first author conducted seven interviews in total, with six taking place via Microsoft Teams and one in person. Conducting all interviews under the guidance of a single interviewer ensured consistency in the questioning approach and data collection. To facilitate interview, participants received the interview guide in advance via email.

The study maintained ethical protocols throughout the data collection process. All participants received the information about the study's objectives and data management procedures. Written consent was obtained from each participant prior to their involvement, ensuring informed and voluntary participation in the research.

Data Analysis

The interview data were analysed using NVivo 14, a qualitative data analysis software, to manage and code the data. Following grounded theory methodology [15], the process began with open coding, which involved identifying patterns and themes in the data. Researchers documented observations and recurring concepts related to design thinking and its integration into engineering education. To refine the analysis, the approach [16] was used to identify indicators of challenges within the interview data. Linguistic cues such as “I am not sure,” “challenging,” and “difficult” were examined as markers of potential areas of concern[17]. These expressions helped categorize data and uncover patterns that shaped conceptual themes.

4 FINDINGS

4.1 Understanding of Design Thinking

Based on participants' narratives, the findings highlight the diverse ways in which design thinking is understood and applied within engineering education. As shown Table 2, these dimensions form a multidimensional understanding of Design Thinking in engineering education.

Table 2 Classification of Design Thinking Approaches Among Participants

Design Thinking	Explanation	Participant ID
Process	Step-by-step approach to integrating design thinking into the curriculum, including stages such as empathy, define, ideate, prototype, and test.	ID-1, ID-4, ID-5
Method	Specific techniques and strategies used to teach design thinking, such as brainstorming sessions, user research, prototyping, PBL, and CDIO.	ID-2, ID-3, ID-4, ID-6, ID-6
State of Mind	Developing a reflective and inquisitive mindset among students, enabling them to approach problems with an open and analytical perspective.	ID-4， ID-7

For instance, as a Process, design thinking follows structured steps—empathy, problem definition, ideation, prototyping, and testing. These stages not only provide students with action plans but also develop their systems thinking skills. This process-orientated approach to design thinking is particularly suitable for teaching scenarios with complex problems, such as interdisciplinary projects or real engineering problems.

Design thinking as a Method is reflected in the specific strategies and tools that educators employ in their teaching practices. During the interviews, participants emphasised the use of a variety of pedagogical methods such as brainstorming, user research, rapid prototyping, project-based learning (PBL), and the CDIO (conceive-design-implement-operate) framework. These methods translate theoretical knowledge into practical competencies through hands-on practice and teamwork.

Additionally, design thinking promotes as a State of Mind, encouraging students to stay flexible and innovative when dealing with uncertainty. Participants mentioned that this mindset helps students to keep an open mind when faced with uncertainty, which leads to a better understanding of complex problems and innovative solutions.

4.2 Key Dilemmas

Through coding and thematic development, the analysis identified six major themes, as shown in Figure 4. Below, the identified themes from the thematic analysis are described.

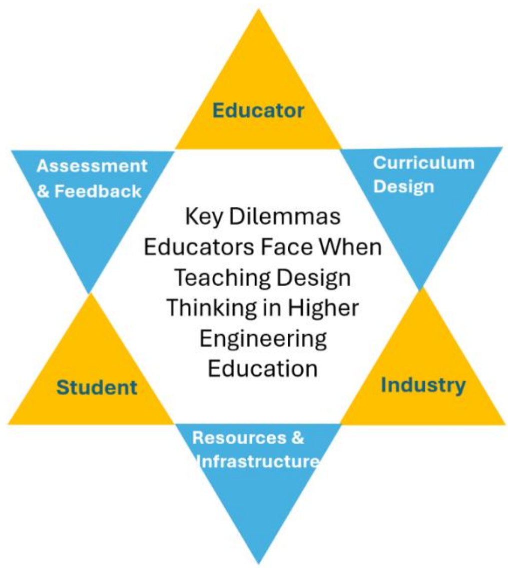

Figure 4 Key Dilemmas Educators Faced

Educator Roles and Challenges

Identity Reconstruction

For educators without design backgrounds, teaching design thinking involves adapting their pedagogical roles and competencies. The distinction between engineering and design backgrounds—defined by systematic study or coursework related to design during undergraduate or doctoral education—shapes their teaching practice. This transition leads educators to examine their qualifications and effectiveness, as they consider the role of design background in their teaching.

The limited design training influences educators' confidence and teaching outcomes. ID-1 captures this perspective, stating, "We could argue whether you need to be a design background person to be a good educator in design skills..." This highlights the relationship between professional expertise and perceived qualifications. Similarly, ID-7 reflects on these challenges, noting, "At the beginning, I don't really have... the kind of design thinking background to teach it confidently. It's... challenging because my expertise is in engineering, not design." These experiences show how limited design-specific training affects confidence during the adaptation to teaching design thinking.

Training and Preparation Gaps

Educators teaching design thinking face challenges with training and practical experience, particularly those with engineering backgrounds. Their academic and professional experiences often focus on structured problem-solving approaches rather than the iterative processes used in design thinking.

ID-4 describes this challenge, noting, "I feel that I lack the kind of deep, hands-on experience in design thinking that could truly enhance my teaching." This reflects the gap between engineering expertise and design thinking instruction. ID-3 shares their experience: "Initially, when working on my own, I often felt underprepared to effectively teach design thinking. However, through lesson preparation and discussions with fellow educators, I realized that it's possible to understand and internalize key concepts in a short time." These experiences indicate that while educators may initially feel unprepared, preparation and collaboration can help address these gaps.

Educators with design backgrounds (ID-4, ID-5, and ID-6) draw from their prior knowledge when teaching design thinking. Their experience with iterative processes supports their instruction. Those without design training (ID-1, ID-2, ID-3, and ID-7) encounter different challenges. These educators often need additional resources to adapt their engineering mindset to design thinking methods.ID-7 describes this transition: "Shifting away from the traditional linear engineering methods that many of us, including myself, were trained in. These methods are deeply ingrained—not just in how we teach, but also in how students approach problem-solving. They're used to following a structured path: define the problem, solve it, move on. But design thinking is iterative." This observation shows how teaching practices and problem-solving approaches need to adapt.

Lack of Professional Development Opportunities

Participants across backgrounds note the limited exposure to design thinking in their academic training. ID-6 reflects on this challenge: "To be honest, I'm always wondering... did I pick the right tools? Am I... you know, teaching this the right way." This perspective indicates the complexity of teaching design thinking, which involves flexible and iterative approaches rather than fixed methods. The participants connect this gap to design thinking's recent emergence in engineering education, as it was not included in their university studies.

As design thinking gains prominence, educators identify gaps in professional development resources. ID-5 notes: "There are very few professional development opportunities specifically aimed at design thinking." This observation indicates the challenges educators face in developing their teaching capabilities. Participants seek structured development pathways, including workshops and training programs, to enhance their ability to teach this evolving aspect of engineering education.

Student Learning and Adaptation

Recognizing Value in Design Thinking

The relationship between technical expertise and design thinking presents an initial barrier for many students. The emphasis on technical proficiency in engineering education appears to shape students' expectations about what constitutes valuable learning experiences. ID-7's observation captures this challenge: "Engineering students struggle to recognize the value of design thinking. They view it as unrelated to their technical expertise, which creates a disconnect between their expectations and the broader goals of the course." This perception suggests that students' prior technical training may inadvertently create resistance to design thinking approaches.

The transition from linear to iterative thinking processes represents another significant adjustment. ID-2 notes: "Students often struggle with iterative thinking because they are accustomed to linear processes." This observation points to a fundamental tension between traditional engineering education methods and design thinking principles. ID-4's characterization of this transition as "an uphill battle, but essential for fostering true innovation" suggests that while challenging, this cognitive shift is crucial for developing innovative capabilities.

Dependence on Tools like AI

While integrating artificial intelligence (AI) tools into design thinking education offers opportunities, it also presents challenges. ID-3 notes a tendency toward over-reliance: "Students start to rely too much on AI—they stop thinking critically." This tendency toward over-reliance on AI tools suggests a need to examine how these technologies influence student learning patterns.

ID-6's insight adds another dimension: "Generative AI is useful. But students need to understand its limitations, or they'll just stop exploring beyond what AI gives them." This points to the delicate balance between utilising technological tools and keeping students engaged in creative problem solving. The challenge extends beyond tool usage to understanding how AI integration affects students' approach to design thinking and creative exploration.

Curriculum Design and Teaching Methods

Time Management in Design Education

Participants frequently mentioned the challenge of time constraints in semester-based courses. Design thinking, as an iterative and exploratory process, demands sustained engagement and deep reflection, which are difficult to achieve within a single term. ID-4's observation that "Design thinking is a process that thrives on time and depth. A single semester barely scratches the surface—it takes at least a year of sustained practice and exploration to truly achieve meaningful results" suggests a fundamental misalignment between traditional academic timeframes and the developmental nature of design thinking skills. This temporal constraint affects the depth of learning possible within conventional course structures. ID-5's comment that "There's so much potential for hands-on, practical projects to enhance design thinking education, but time constraints prevent us from fully integrating these opportunities into our curriculum" further illuminates how time limitations impact pedagogical choices.

Pedagogical Approaches

Another recurring theme is the tension between fostering creativity and providing enough structure to guide students effectively. ID-4 reflects, "Should I encourage radical, free-form design thinking, or stick to more structured, step-by-step methods" reveals the complex decisions educators face in structuring their teaching approaches. This dilemma suggests that finding the right balance between guidance and creative freedom significantly influences learning outcomes. ID-1's approach of trying to "balance strict engineering guidelines with the need for design-related teaching" indicates an ongoing effort to integrate design thinking within established engineering education frameworks. This balance appears crucial for maintaining academic rigor while fostering the creative and iterative aspects of design thinking.

Resources and Infrastructure

Resources Constraints

The financial constraints highlighted by ID-2's observation that "Funding for digital platforms and prototyping tools is insufficient to support our envisioned projects" indicates a fundamental gap between pedagogical aspirations and resource availability. This limitation appears to restrict the scope of educational innovation and practical application opportunities in design thinking education.

Infrastructure Constraints

The allocation of resources and access to physical infrastructure, such as makerspaces and laboratories, presents another significant challenge. While specialized resources can provide depth, accessibility issues often emerge, particularly for large student cohorts. ID-3 described this as a "double-edged sword," noting, "Specialisation is nice, but also a double-edged sword... Access to facilities and resources can be challenging sometimes." Large class sizes further exacerbate these challenges, creating additional complexity in ensuring equitable access to resources. As ID-3 pointed out, "Scale is the other challenge... sometimes, accessing facilities and resources can be difficult." Balancing the needs of diverse and large student groups while maintaining equitable access to resources requires careful planning and institutional support. Physical constraints also limit the scope of hands-on projects and iterative processes essential to design thinking. ID-5 emphasized logistical difficulties, stating, "Access to facilities and resources can be challenging sometimes... because we can't put all of our students within the making space at the same time." This limitation impacts students' ability to engage fully with the iterative design process and reduces opportunities for immersive learning.

Industry Collaboration

Resource Dynamics in Industry Partnerships

The development of effective industry collaborations appears constrained by both structural and operational factors. ID-6's observation that "Establishing and maintaining these collaborations can be difficult" points to underlying challenges in sustaining meaningful partnerships. This suggests that successful industry engagement requires not only initial connection but ongoing institutional support and resource allocation.

The scale of educational programs emerges as a critical factor affecting collaboration quality. ID-2's insight that "In large-class settings, coordinating industry collaborations becomes even more complex" indicates that traditional partnership models may not scale effectively. This observation suggests a need to rethink how industry engagement can be structured to accommodate larger student cohorts while maintaining educational value.

Guest Lectures Integration

The integration of industry expertise through guest lectures shows tensions between practical insights and academic requirements. ID-4's reflection captures this complexity: "When you bring in industry partners, yeah, it's exciting... but there's this constant struggle. Deadlines, expectations, and inconsistent evaluation standards from external collaborators can make things challenging." This suggests that while industry engagement offers valuable real-world perspectives, misaligned expectations can compromise educational outcomes.

ID-3's observation about early-stage partnerships. "We are starting to develop some partnerships to do joint projects and joint curriculum development, but it's still in the early stages" - indicates a developmental phase in industry-academia collaboration.

Learning Assessment and Feedback

Performance-Based Assessment

The current approach to evaluation emphasizes measurable outcomes and technical requirements. As captured in one participant's observation: "So, like how successful were they in developing a system that meets the requirements that we give them and how much they've exceeded those requirements as well. So, we definitely do measurements of performance." This focus on quantifiable metrics suggests an attempt to maintain objectivity in assessment, reflecting traditional engineering education practices.

However, this emphasis on measurable performance creates potential limitations in evaluating the full spectrum of design thinking capabilities. The iterative nature of design processes, where learning often occurs through experimentation and refinement, may not be adequately captured by conventional performance metrics. This suggests a need to expand assessment frameworks to recognize the value of exploratory approaches and intermediate outcomes in the design process.

Creative Assessment Framework

Evaluating creativity remains a particularly complex challenge in design thinking education. ID-3 reflected on this difficulty, noting, "Creativity assessment is inherently subjective. How do we determine whether a design is genuinely innovative or simply meets the basic requirements?" This statement highlights the challenge of measuring innovation within academic contexts, where traditional assessment methods may struggle to capture the nuanced aspects of creative problem-solving. Similarly, ID-2 voiced a comparable concern, stating, "Honestly, assessing creativity… it's so subjective. How do you even measure... whether a design is innovative or just good enough?" These insights show a significant gap in current evaluation practices, particularly in engineering education, where traditional methods often prioritize technical precision over creative innovation. Addressing this challenge will require the development of consistent and fair criteria that account for the multifaceted nature of creativity in design thinking.

5 DISCUSSION

The findings highlight that effective integration of design thinking in engineering education depends on interconnected institutional, educator, and student factors. UK engineering programs show inconsistent incorporation of design thinking, with most relying on implicit integration within broader curricula, limiting accessibility and impact.

A trend is the rise of 'accidental design teachers,' educators without formal design training adapting to teach design thinking. This transition requires bridging gaps in expertise, reconstructing professional identities, and navigating a lack of tailored professional development resources. Students also face challenges, often resistant to design thinking’s iterative nature due to traditional engineering's linear problem-solving focus. The integration of AI tools adds complexity, offering creative potential but risking overreliance that stifles critical thinking.

Time and resource constraints, such as limited course durations and insufficient access to makerspaces, further hinder design thinking education. Industry collaborations provide valuable insights but often face logistical and alignment challenges. Finally, traditional assessment methods focused on measurable outcomes fail to capture design thinking’s creative and exploratory dimensions, necessitating a revaluation of evaluation frameworks. Addressing these issues requires institutional support, revised pedagogy, and balanced resource allocation to fully realize the benefits of design thinking in engineering education.

5.1 Limitations of the Study and Suggestions for Future Research

The study has several limitations that should be acknowledged. First, it lacked comprehensive interviews or extensive surveys involving a wider range of stakeholders, such as project coordinators and students, in addition to teaching staff. Including these perspectives could have provided richer insights into the methods employed and their effectiveness in design integration within engineering education. Second, the study’s focus on the UK context limits the generalizability of the findings to other regions. Future research should expand to include diverse geographical contexts to provide a broader understanding of design integration globally.

Additionally, this research primarily concentrated on the implementation of design thinking at the course, curriculum, and framework levels. Institutional policies, faculty development programs, and their potential influence on design education were not explored in depth. Furthermore, the analysis relied heavily on secondary data sources, which may have restricted the study’s ability to provide a nuanced understanding of the topic. Incorporating primary data collection methods, such as direct observations or longitudinal studies, would enhance the comprehensiveness of future research.

6 CONCLUSIONS

This study examines the integration of design thinking in UK undergraduate engineering education, highlighting significant challenges and opportunities for enhancement. Through analysis of curriculum structures and educator experiences, the research identifies key barriers to effective design thinking implementation in engineering programs.

The findings highlight the crucial role of 'accidental design teachers' - engineering educators who must adapt to teaching design thinking without formal design training. These educators face distinct challenges in professional identity, pedagogical adaptation, and confidence development. Their experiences underscore the need for structured support systems and professional development opportunities in design education.

REFERENCES

1. Açar, A. and D. Rother. *Design thinking in engineering education and its adoption in technology-driven startups*. in *Advances in Sustainable Manufacturing: Proceedings of the 8th Global Conference on Sustainable Manufacturing*. 2011. Springer.
2. Barcellos, E.E.I. and G. Botura. *Design Thinking: User-Centered Multidisciplinary Methodology Based on People and Innovation*. in *International Conferences on Human Factors in Management and Leadership, and Business Management and Society / 8th International Conference on Applied Human Factors and Ergonomics (AHFE)*. 2017. Los Angeles, CA: Springer International Publishing Ag.
3. Dym, C.L., et al., *Engineering design thinking, teaching, and learning.* Journal of Engineering Education, 2005. **94**(1): p. 103-120.
4. Ericson, A., et al. *DESIGN THINKING CHALLENGES IN EDUCATION*. in *17th International Conference on Engineering Design*. 2009. Stanford Univ, Stanford, CA: Design Soc.
5. Elsbach, K.D. and I. Stigliani, *Design thinking and organizational culture: A review and framework for future research.* Journal of management, 2018. **44**(6): p. 2274-2306.
6. Latorre-Cosculluela, C., et al., *Design Thinking: Creativity and Critical Thinking in College.* Revista electrónica de investigación educativa, 2020. **22**.
7. Bean, C., *The accidental instructional designer: Learning design for the digital age*. 2023: Association for Talent Development.
8. Li, Y., et al., *Design and design thinking in STEM education*. 2019, Springer. p. 93-104.
9. *"UCAS," [Online]. Available: https://www.ucas.com/. [Accessed: June 2, 2024].*
10. Deng, Y., C. Lucas, and W. Liu. *Implementation and Impact of Design in Higher Engineering Education: A Comprehensive Investigation of the UK Region*. in *2024 ASEE Annual Conference & Exposition*. 2024.

11. Sherman, R.R. and R.B. Webb, *Qualitative research in education: A focus*, in *Qualitative research in education*. 2004, Routledge. p. 2-21.
12. Kallio, H., et al., *Systematic methodological review: developing a framework for a qualitative semi‐structured interview guide.* Journal of advanced nursing, 2016. **72**(12): p. 2954-2965.
13. Braun, V. and V. Clarke, *Conceptual and design thinking for thematic analysis.* Qualitative psychology, 2022. **9**(1): p. 3.
14. Noy, C., *Sampling knowledge: The hermeneutics of snowball sampling in qualitative research.* International Journal of social research methodology, 2008. **11**(4): p. 327-344.
15. Corbin, J. and A. Strauss, *Basics of qualitative research: Techniques and procedures for developing grounded theory*. 2014: Sage publications.
16. Scager, K., et al., *Challenging high-ability students.* Studies in higher education, 2014. **39**(4): p. 659-679.
17. Carenini, G., R. Ng, and G. Murray, *Methods for mining and summarizing text conversations*. 2022: Springer Nature.